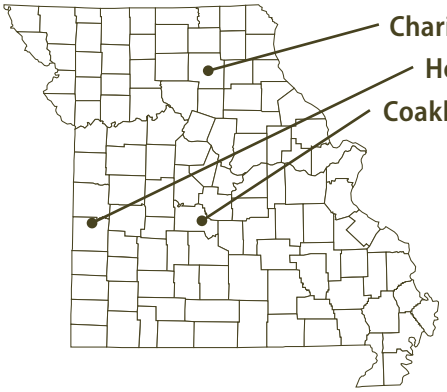
MISSOURI
Natural Areas
NEWSLETTER
Fall 2006

"…identifying, designating, managing and restoring the best remaining examples of natural communities and geological sites encompassing the full spectrum of Missouri's natural heritage"

History of Aquatic Natural Communities in the Missouri Natural Areas System

By Mike Leahy, Natural Areas Coordinator,
Missouri Department of Conservation

NATURAL AREAS FEATURED IN THIS ISSUE



Missouri is blessed with rich aquatic fauna. The Show-Me State ranks ninth in the nation in terms of freshwater fish species diversity, with 200 different kinds of native fishes (Pflieger 1997, Stein 2002). We have 65 species of native freshwater mussels (Oesch 1995) and at least 32 native crayfish species (Pflieger 1996). Some of our fish and crayfish species occur in Missouri and nowhere else in the world, including the Niangua darter and the St. Francis River crayfish. Nationally, freshwater fauna are the most threatened with extinction compared to other taxa (Master et al. 1998, Riccardi and Rasmussen 1999), and here in Missouri the pattern is the same. For example, nearly half of Missouri's freshwater mussel species are of conservation concern. The Missouri Natural Areas System has a definite role to play in conserving this outstanding aquatic biodiversity. With this background information in mind, let us consider the long history of aquatic natural communities within the Missouri Natural Areas System.

Aquatic natural community conservation has been a part of the Natural Areas System since its inception. Two of the original 11 natural areas designated in 1971 by the Missouri Department of Conservation (MDC) featured aquatic natural communities as a principle feature:

- Clifty Creek in Maries County (leased to MDC by the L-A-D Foundation)
- Rogers Creek in Carter County (subsequently absorbed into the larger Stegall Mountain Natural Area in 1993).

Longpincered crayfish* (Orconectes longidigtus) *is restricted to the White River basin of Missouri and Arkansas.
Missouri Department of Conservation

With the landmark advent of the interagency Missouri Natural Areas Committee in 1977 between MDC and the Missouri Department of Natural Resources (DNR), a number of natural areas were added to the system on DNR lands in 1979 that had aquatic natural communities as the principle feature:

- Big Sugar Creek in Lincoln County
- Coonville Creek in St. Francois County
- Locust Creek in Linn County
- Pickle Creek in Ste. Genevieve County.

Huzzah Creek, part of the Middle Meramec Conservation Opportunity Area, identified in the Comprehensive Wildlife Strategy
Missouri Department of Conservation

Federal partners joined the Missouri Natural Areas System in the 1980s. As a result, the National Park Service's Big Spring Natural Area on the Ozark National Scenic Riverway in Carter County and the Mark Twain National Forest's Mud Creek Natural Area in Butler County were early natural area designations on federal lands with aquatic natural communities.

Today, we have 182 natural areas on public and privately owned lands. Only about 17 natural areas (the earliest of which are listed above) were designated primarily to conserve aquatic natural communities, and another 47 natural areas conserve aquatic natural communities but were designated primarily for their terrestrial features.

But how did we get here? The story of aquatic natural communities and natural areas started in the late 1960s with the formation of a Conservation Department Natural Areas Committee headed by assistant director Allen Brohn. John Funk represented MDC's fisheries program on this new committee. The Conservation Commission established the Natural Areas System in 1970 and the interagency Natural Areas System was created in 1977 shortly after passage of the Design for Conservation sales tax amendment. Aquatic biologists with MDC have been on the Department Natural Areas Committee (DeNAC) and Missouri Natural Areas Committee (MoNAC) from the beginning of the program and have been crucial in providing expertise and guidance on aquatic natural communities. Aquatic professionals serving on these committees have included John Funk (1967-1974), Bill Pflieger (1974-1994), Stan Michaelson (1995), Gary Novinger (1995-2004) and Marlyn Miller (2005—present).

Bill Pflieger, MDC fisheries research biologist from 1961-1995, deserves special recognition for his work on aquatic natural communities, fishes, and crayfishes of Missouri. Pflieger was instrumental in developing the aquatic natural community classification used in the Natural Areas System, and he was responsible for nominating the majority of the natural areas with aquatic natural features to date. An aquatic natural community classification used for the Natural Areas System was originally developed by Bill Pflieger and John Funk in 1974. The first edition of *Fishes of Missouri* was published by Pflieger in 1975 based upon his doctoral dissertation from the University of Kansas and subsequent field work. In 1989, Pflieger wrote the *Aquatic Community Classification System* for Missouri that has been the standard reference for the Missouri Natural Areas System to date. The second edition of *Fishes of Missouri* (1997) and *The Crayfishes of Missouri* (1996) both by Pflieger rounded out an extraordinary career that contributed hugely to the goals of the Natural Areas System. Some of the natural areas nominated by Pflieger include Brush Creek, St. Francis River and Whetstone Creek.

From 1981-2001, the Missouri Natural Features Inventory, housed out of MDC but working with funding and assistance from many partner agencies and organizations, provided for a systematic county-by-county inventory of the natural features of the state. The methods for this inventory were adapted from those developed by the Illinois Natural Areas Inventory (1978). Inventory biologists did a superb job in identifying, locating and documenting terrestrial species and natural communities of conservation

Globally the U.S. ranks first in its species diversity of freshwater mussels, crayfish, and snails, and seventh in freshwater fish species diversity.

Master *et al.* 1998, in *Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity.*

The federal and state-listed Niangua darter (*Etheostoma nianguae*) occurs in the Brush Creek Natural Area in St. Clair County.
Missouri Department of Conservation

concern for the Missouri Natural Heritage Database. However, the Natural Features Inventory fell short when it came to aquatic natural features because the biologists who conducted and ran the Natural Features Inventory were all from terrestrial ecology backgrounds. The Natural Features Inventory relied upon the expertise of Bill Pflieger and other aquatic ecologists to determine significant aquatic natural features sites. The Natural Features Inventory itself was not a systematic sample of aquatic biodiversity.

Most of the members of DeNAC and MoNAC have historically been terrestrial-based biologists by training. Aquatic natural communities pose special challenges for natural area designation, which has contributed to their poorer representation in the system. Aquatic natural communities are more difficult to protect and issues of watershed protection are paramount. Some of the articles in this issue of the *Missouri Natural Areas Newsletter* describe the difficulties inherent in conserving aquatic natural feature sites. But, there certainly are opportunities for better representation of aquatic natural communities in the Missouri Natural Areas System.

Building upon Pflieger's aquatic natural community classification, today we have a Missouri Aquatic Ecological Classification System developed by Scott Sowa and others of the Missouri Resource Assessment Partnership (Sowa et al. 2004). This geographic information systems-based tool is an integration of multiple physical and biological data layers including nearly 7,000 collection records for fish, mussels and crayfish. These biological data come from many hours of aquatic biologists' sampling efforts from numerous agencies and universities over several years. Using this framework, an aquatic biodiversity assessment of the state was completed (Sowa et al. 2004). The result of this assessment was the identification of aquatic Conservation Opportunity Areas that were then used in developing Missouri's Comprehensive Wildlife Strategy. The Missouri Natural Areas Committee is in the process of considering whether to adopt the Missouri Aquatic Ecological Classification System, presented in the next article, or a modification of it, as the new standard for aquatic natural community classification.

The history of aquatic natural communities in the Natural Areas System is long and productive, but much work remains. Due to the hard work of many aquatic biologists over the years, we have a good data set with which to begin the work of completing the representation of aquatic natural communities in the Natural Areas System. Decisions will need to be made as to how much land-use management capability over a watershed is required for designating a natural area for an aquatic natural community. Watershed health is inherent in designating aquatic natural areas and must be considered. The aquatic-based Conservation Opportunity Areas identified through the Missouri Comprehensive Wildlife Strategy provide an excellent starting point to move forward in nominating new natural areas with aquatic natural communities as their principle features. ▲

Master, L.L., S.R. Flack, and B.A. Stein, eds. 1998. Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity. The Nature Conservancy, Arlington, Va.

Oesch, R.D. 1995. Missouri Naiades: A Guide to the Mussels of Missouri. Missouri Department of Conservation, Jefferson City, Mo.

Pflieger, W.L. 1996. The Crayfishes of Missouri. Missouri Department of Conservation, Jefferson City, Mo.

Pflieger, W.L. 1997. The Fishes of Missouri. Missouri Department of Conservation, Jefferson City, Mo.

Riccardi, A. and J.B. Rasmussen. 1999. Extinction Rates of North American Freshwater Fauna. Conservation Biology 13: 1220-1222.

Sowa, S.P., D.D. Diamond, R. Abbitt, G.M. Annis, T. Gordon, M.E. Morey, G.R. Sorensen, and D. True. 2004. The Aquatic Component of GAP Analysis: a Missouri Prototype. Missouri Resource Assessment Partnership. Final Report submitted to U.S. Department of Defense Legacy Program, Projects 981713 and 991813.

Stein, B.A. 2002. States of the Union: Ranking America's Biodiversity. Arlington, Va.: NatureServe.

A Riverine Ecosystem Classification System for Missouri: A Tool for Natural Area Designation and Management

By Scott Sowa, Assistant Director, Missouri Resource Assessment Partnership, University of Missouri

Missouri contains much of our nation's freshwater biodiversity, including several species such as the Niangua darter and freckled crayfish that are found nowhere else. A total of 364 native freshwater animal species and subspecies (32 crayfishes, 56 snails, 65 mussels and 211 fishes) have been collected from our state's freshwaters. In addition, scientists have documented approximately 2,000 freshwater macroinvertebrate species, such as mayflies and dragonflies. Only a handful of southeastern states contain more species.

Most of the faunal diversity, for obligate freshwater species, is found within our riverine ecosystems. This rich diversity is primarily the result of three factors operating over both contemporary and evolutionary time frames. First, the physiographic diversity of the state provides the template for an amazing array of stream habitats. Second, our freshwater ecosystems are part of the Missouri and Mississippi River Basins, which were two principal refugia for freshwater organisms during Pleistocene glaciation. Third, the Ozarks, which contain most of our freshwater biodiversity, is a very old unglaciated landscape with many isolated drainages that have promoted and allowed divergent evolutionary processes to proceed for millions of years.

Unfortunately, only a small fraction of Missouri's freshwater biodiversity is contained within our state's 182 natural areas. Seventy of the natural areas contain some freshwater element, whether a fen, swamp, spring, lake or stream. However, only 22 natural areas, or 12 percent, contain stream habitats and a number of these were captured "by accident" in natural areas established to protect terrestrial communities. There are many reasons that our Natural Area System is biased toward the protection of terrestrial communities. One reason, as Tim Nigh pointed out in the Fall 2005 issue of this newsletter, has been a lack of the consistent application of an aquatic classification system for the purpose of conducting inventories of freshwater ecosystems, which has hindered the designation of natural areas to protect aquatic biodiversity. The remainder of this article provides an overview of a riverine classification system for Missouri that could help overcome this problem.

As part of the Missouri Aquatic GAP Project, the Missouri Resource Assessment Partnership (MoRAP), in cooperation with The Nature Conservancy developed an eight-level classification hierarchy. The classification hierarchy, which was constructed within a geographic information system (GIS), attempts to account for both the contemporary and evolutionary factors responsible for spatial patterns of freshwater biodiversity. Levels 1-3 and 5 account for spatial variation in taxonomic (species and genetic) composition resulting from distinct evolutionary histories, while levels 4 and 6-8 account

Medicine Creek (right) is a perennial warmwater small river with a relatively moderate gradient flowing through limestone that occurs within the Sampson Creek AES-Type in the Grand/Chariton EDU of the Central Plains Aquatic Subregion. Turkey Creek (left) is a perennial warmwater creek with a relatively high gradient flowing through igneous that occurs within the Little St. Francis River AES-Type within the Upper St. Francis/Castor EDU of the Ozark Aquatic Subregion.
Missouri Department of Conservation, Jim Rathert

for spatial variation in ecosystem structure, function, and the functional composition (such as reproductive or foraging strategies) of riverine assemblages.

Following are brief descriptions of each level in the hierarchy. More detailed descriptions can be found in the Missouri Aquatic GAP Final Report, at: www.cerc.usgs.gov/morap/projects/aquatic_gap/Aquatic_GAP_Final_Report.asp?

LEVELS 1-3: ZONES, SUBZONES AND REGIONS

The upper three levels of the hierarchy are largely zoogeographic strata and account for spatial variation in taxonomic composition which have resulted from distinct evolutionary histories (such as Pacific versus Atlantic drainages; see Maxwell et al 1995). Missouri falls within the Nearctic Zone, Arctic/Atlantic Subzone, and Mississippi Region. Because our state is fully contained within each of these levels, they do not come into play for state-level inventories or planning. However, the ecological context provided by these levels is important for planning at coarser scales.

LEVEL 4: AQUATIC SUBREGIONS

Aquatic subregions are essentially physiographic substrata of regions. They broadly account for spatial variation in the functional composition of riverine assemblages that result from spatial variation in ecosystem structure and function. For instance, fish species found in streams draining the Central Plains of northern Missouri generally have greater physiological tolerances for low dissolved oxygen and high temperatures than species restricted to the Ozarks. The three aquatic subregions that cover Missouri—Central Plains, Ozarks and Mississippi Alluvial Basin—largely correspond with the aquatic faunal regions of Missouri (Pflieger 1989).

LEVEL 5: ECOLOGICAL DRAINAGE UNITS

Embedded within aquatic subregions are spatial variations in taxonomic composition (species- and genetic-level) resulting from the distinct evolutionary histories of the major drainages within each subregion. Level 5 of the hierarchy, Ecological Drainage Units (EDUs), accounts for these differences. EDUs are analogous to "islands" when viewed within the context of the surrounding aquatic subregion, which is analogous to the "sea" in which the EDUs reside. Within an aquatic subregion, all EDUs have functionally similar assemblages. However, the taxonomic composition within each EDU is relatively distinct due to divergent evolutionary processes. Seventeen EDUs were delineated for Missouri: five in the Central Plains, nine in the Ozarks and three in the Mississippi Alluvial Basin.

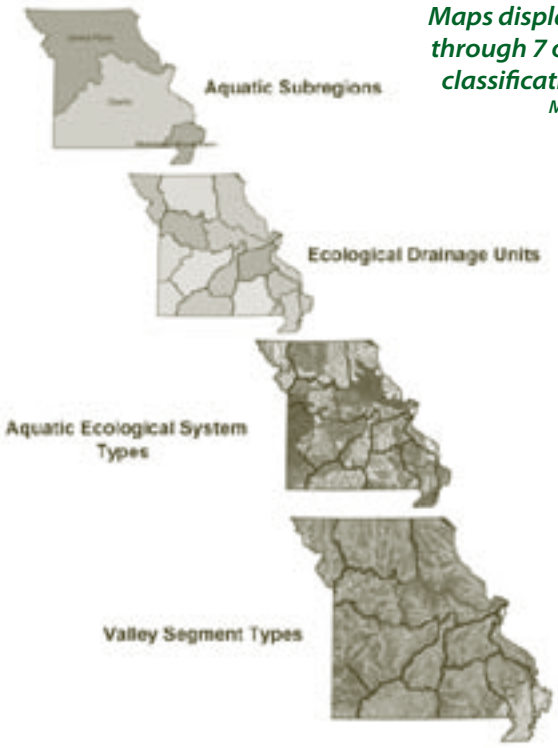
Wetlands originally composed about 87 million ha of the lower 48 United States.

K. Barton, 1986, in *Audubon Wildlife Report.*

LEVEL 6: AQUATIC ECOLOGICAL SYSTEM TYPES

Within each aquatic subregion (Level 4) there exist more subtle variations in physiography that also create spatial variation in stream habitat conditions and the functional composition of local riverine assemblages. One example of these subtle influences is seen by examining species distributions and replacements that occur throughout the Meramec River watershed in the Ozarks. The Bourbeuse and Dry Fork subwatersheds are covered with a mantle of Pennsylvanian (PN) sandstone and shales, while the rest of the Meramec watershed is underlain by Ordovician limestones and dolomites. Because PN geologic strata are poor aquifers, there are significantly fewer springs in these subwatersheds, the water is warmer in summer and cooler in winter, and the streams have lower gradients. Also, the hydrographs are flashier, the water more turbid and the streambeds are composed of more fine substrates compared to the remainder of the Meramec watershed. These differences in stream habitat result in dramatic differences in the aquatic assemblages throughout the Meramec, most notably by the absence of several characteristic Ozarkian fish, mussel and crayfish species from the Bourbeuse and Dry Fork subwatersheds.

To account for finer-resolution physiographic controls, we grouped 534 hydrologic units into distinct Aquatic Ecological System Types (AES-Types). AES-Types define groups of hydrologic units with relatively similar combinations of geology, soils, landform and groundwater influence. Another way of viewing this level of the hierarchy is that each AES-Type represents a group of hydrologic units that have a relatively similar combination of Valley Segment Types (see Level 7). A total of 39 AES-Types was identified and mapped. Each type was named based on the name of a major stream contained within a typical AES of a given AES-Type.



Maps displaying levels 4 through 7 of the MoRAP classification hierarchy
MoRAP, Scott Sowa

LEVEL 7: VALLEY SEGMENT TYPES

In Level 7 of the hierarchy, we mapped Valley Segment Types (VSTs) to account for the longitudinal variation in ecosystem structure and function that is prevalent in lotic environments. VSTs represent hydrogeomorphic units defined by local physical factors and their position within the broader stream network. They stratify stream networks into major functional components that define broad similarities in fluvial processes, sediment transport, riparian conditions and thermal regimes. Each individual valley segment is a spatially distinct habitat, but valley segments of the same size, temperature, flow, gradient, etc., all fall under the same VST. Excluding the Missouri and Mississippi rivers, there are 74 VSTs (29 headwater, 23 creek, 14 small river and eight large river) in our classification.

LEVEL 8: HABITAT TYPES

Units of the final level of the hierarchy, Habitat Types (e.g., high-gradient riffle, lateral scour pool), are too small and temporally dynamic to map within a GIS across the state. However, it is important to recognize this level, since it is a widely recognized component of natural variation in riverine ecosystems.

Certainly, the first step to effective resource management is having an accurate inventory, and the only way to generate an inventory is to have a classification. We fully recognize that by classifying the natural world into discrete units we are often placing somewhat arbitrary boundaries on a continuum. However, it is not possible to generate an inventory for a continuum. To effectively conserve biodiversity we must demonstrate the extent of the problem and thus the need for policies and actions. The only way to do this is through a systematic accounting of the elements of biodiversity, not simply species, but also the ecosystems and habitats that sustain them. Only then will we be able to answer fundamental questions like: How many types of ecosystems/assemblages exist? How many of each remain? Where are they? Which ones are represented in natural areas? Failure to answer these questions will relegate the conservation of biodiversity to haphazard preservation of fragments of disintegrating systems. Our classification system allows us to answer these questions; and because the data are in a GIS format, we can answer questions efficiently in a spatially explicit manner.

The utility of our classification system was put to the test last year when it was used to assist in the development of the aquatic component of the state's Wildlife Action Plan. We developed separate conservation plans for each EDU. We sought to identify a set of Conservation Opportunity Areas (COAs) that represented all of the AES-Types, VSTs, and multiple populations of all target species within each EDU. The 158 COAs that were identified and mapped provide a blueprint for holistic conservation of the freshwater ecosystems within Missouri. These areas can be used to guide protection efforts such as natural area designation, restoration efforts and regulatory activities.

I truly believe that this classification system can be used as a tool for the designation and management of natural areas that seek to protect our state's rich diversity of freshwater ecosystems. One step toward making this a reality will be taking place this fall when we begin working with the folks in the Missouri Natural Heritage Program to possibly incorporate our classification framework into the Natural Heritage Database. ▲

Maxwell, J. R., C. J. Edwards, M. E. Jensen, S. J. Paustian, H. Parrott, H., and D. M. Hill. 1995. A hierarchical framework of aquatic ecological units in North America (Nearctic Zone). St. Paul, MN: U.S. Forest Service, North Central Forest Experiment Station, General Technical Report NC-176.

Pflieger, W. L. 1989. Aquatic community classification system for Missouri. Missouri Department of Conservation, Aquatic Series No. 19, Jefferson City, Mo.

Conserving Riverine Natural Communities

By Charles Rabeni, Leader, Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia

When it becomes known that I work on fishes in streams for a living, I'm often asked the question: "So what is the condition of our streams, and are they getting better or worse?" It is a seemingly simple, straightforward question but also slightly embarrassing for me. Embarrassing because the only answer I can give is "I really don't know." From a few specific examples from my own experience, commiserating with other experienced professionals like Bill Pflieger and Otto Fajen, and questioning long-time residents of stream-side property I have developed a gut feeling that overall our streams are in worse shape than they were a couple of decades ago. (No old-timer has ever told me fishing is better than it was when he was a kid.) But as a scientist I know I sorely lack the evidence to generalize about Missouri, and that my opinions will not and should not weigh heavily in affecting public policy on stream management. What is needed to combat a perceived deterioration in many of our streams is a comprehensive statewide program for assessing and reporting existing conditions and for detecting changes over time.

Advocacy for conservation of streams in Missouri would be well served by having a clear understanding of their ecological condition—a measurement of present status and recent trends

Because of tremendous wetland loss and degradation, resource managers have responsibilities to protect wetlands that retain natural hydroperiods and ecological functions and to manage wetlands disrupted by human activities.

M. Weller, 1988, in *Freshwater Marshes: Ecology and Wildlife Management.*

to which goals could be attached to measure progress. Many disciplines have taken complex interacting phenomena and expressed them in a simple, understandable form. Economists have economic indicators and physicians have health indicators, both useful in helping us interpret important aspects of our lives. Likewise, an ecological indicator, one based on sound science from a respected source, would allow the average citizen to easily understand whether the ecological situation is static, worsening or improving. Progress in stream conservation would be more likely if we had an unambiguous report card that citizens, policymakers and Jefferson City politicians could relate to either for a particular stream of interest or streams on a regional or statewide basis. Public understanding would increase, resource managers could manage more efficiently and intelligently, and public policy debates would have a scientific basis.

A successful program requires money (but not that much more than currently expended), time and commitment from numerous agencies, organizations and individuals. We're talking serious commitment here. I see two principle parts to this program: (1) a system for obtaining and organizing the information, and (2) a separate element for the packaging, reporting and advocacy elements. I make this distinction because biologists are specifically trained to do science. As a result lots of very compelling information never gets very well integrated into the public discourse. Pharmaceutical companies don't ask their scientists who make breakthroughs on drugs to then go and sell their discoveries to doctors. Maybe stream biologists should leave the marketing to those trained in that area. I'm sure an effective job could be done by human dimensions experts located in NGO's; such as Audubon, The Nature Conservancy, Sierra Club, American Rivers and many others. The involvement of the Missouri Conservation Federation seems appropriate. Imagine a bi-annual report on status and trends of Missouri streams to the citizens of Missouri by a respected organization based on credible information collected by a variety of state agencies, consulting firms, and universities and even perhaps ordinary citizens, such as Stream Teams.

There are major challenges to the establishment of a successful program. First we need agreement on a measure of stream condition. Most state water quality criteria are based on physical and chemical standards, generally because of ease of measurement. These criteria are, at best, weakly related to the condition of aquatic life. So it seems intuitive that if our interest is primarily what's living in the stream, the indicator of stream condition should be aquatic life. This was the intent of the federal Clean Water Act enacted over 30 years ago which mandated our streams and rivers to be "fishable and swimmable" and possess "biological integrity." Missouri recognizes the importance of this and has included aquatic life criteria—albeit on a narrative, not quantitative basis—into the Missouri Water Quality Standards.

Indicators of the quality of aquatic life can profitably focus on endangered species (e.g., Niangua darter), native sport fish (e.g., smallmouth bass) or the entire biotic community (either fishes or invertebrates). Communities have been used most often in this regard and have some particular advantages in delineating overall ecosystem performance. Both fish and invertebrates have been fairly well studied in Missouri. Knowledge of life histories, habitat preferences, physiological tolerances, reproductive traits and feeding preferences is available. These ecological traits of stream animals can be used to construct "multimetric indices" which indicate, in a single understandable number (for example 1 being bad and 10 being great), natural processes occurring in the stream. These indices allow comparisons among streams that harbor different types of animals. Thus, indices that incorporate such things as an organism's silt tolerance, food limitations, habitat required for reproduction, and temperature preferences can capture overall stream condition. This system is based on the premise that streams in unaltered watersheds represent the natural and preferred condition and should be considered the "reference condition." All other streams are judged in relation to the reference condition.

Biological monitoring of streams is a common activity in Missouri. At the federal level intensive, but limited, activity is evident in the US EPA REMAP program, the USGS NAWQA effort and the National Park Service programs on their lands. At the state-government level the effort is led by the Department of Natural Resources Water Protection Program where statewide biological criteria were developed for stream invertebrates, and the Department of Conservation's emerging Stream Resource, Assessment and Monitoring (RAM) program, that involve both invertebrates and fish. There are some other programs that incorporate periodic monitoring of select streams by universities and watershed organizations. Stream Teams are becoming increasingly involved in biological sampling. Unfortunately there is little coordination among programs and few attempts to standardize collection or reporting methods. A great need exists for a centralized clearinghouse where data could be collected and integrated.

Fortunately protocols for obtaining and interpreting biological data have been available for years and are being or have been modified for the situation in Missouri. Many problems on the biological end remain; for example, how do we best monitor very small or very large streams. But these problems are all tractable. Existing programs in DNR and MDC are addressing these weaknesses. There are also major

constraints that are not biological. We need major agreements, coordination and commitment among agencies, organizations and universities. Commitments for long-term funding, data gathering and synthesizing and a plan for continual updating are needed. Involvement of Stream Teams also is possible.

Natural areas certainly have a role to play in this effort. By definition these locations represent the best of many types of habitats. Those natural areas possessing streams could serve as benchmark reference situations. Criteria for new natural areas might be developed with the objective of acquiring reference stream segments in a greater variety of physiographic settings than now exist. Having reference streams in natural areas solves the problem that many candidate or designated reference streams are not protected and very susceptible to development and degradation. The fact that natural area managers are expected to monitor their areas should make it easier to incorporate them into a broader context.

The development of a statewide stream health report is in principle fairly straightforward. I did not say it would be easy. Time is not on our side. Developmental pressures near major metropolitan areas, conversions of forest to pasture in the Ozarks, and destruction of riparian vegetation in our plains and prairie regions all highlight the need for a program to provide information to combat possible irreversible widespread deterioration in the years ahead. ▲

Any opinions expressed are those of the author and do not represent the official policies or opinions of his employer the U.S. Geological Survey.

Coakley Hollow Fen Natural Area: Invertebrates as Indicators of Community Quality

By Cindy Hall, Park Naturalist, Lake of the Ozarks State Park, Missouri Department of Natural Resources

Ozark fen at Coakley Hollow Fen Natural Area
Missouri Department of Natural Resources

Imagine hiking early in the morning, just as the sun rises. The heat and humidity, typically found in the Ozarks, are not yet a concern at this time of the day. As you hike, you notice a prothonotary warbler (*Protonotaria citrea*) that has just snatched a mayfly, sitting in a willow tree. It is comforting to see this bird as it is on the Partners in Flight watchlist for the Ozarks. Nearby, the bright yellow of a Riddelli's goldenrod (*Oligoneuron Riddellii*) catches your eye. This wetland obligate is teeming with many small insects and spiders, some colored to exactly match the flowers. Glancing around, you notice a small mound of mud with a hole in the center. Upon further investigation, several of these "chimneys" appear. A quick check of your species list for the area reveals that the digger crayfish (*Fallicambarus fodiens*) may be lurking deep within these carefully constructed mounds. Unfortunately your chances of seeing one are slim. They emerge only briefly to forage.

As you continue your journey, the sun rises further into the sky and heat and humidity return. It is early afternoon and you spot a swamp metalmark (*Calephelis mutica*) flittering by. It stops and sips the nectar of the swamp milkweed (*Asclepias incarnata*). You decide to take a rest and dip your feet into the clear, spring-fed stream. As you do so, movement in the water catches your eye. A closer look revels several bleeding shiners (*Luxilus zonatus*) slowly swimming in the crystal clear water. The water feels good and you decide to go wading. You reach down to pick up a rock and suddenly it moves. The Ozark sculpin (*Cottus hypselurus*) has revealed itself. As you watch it lurches forward to capture its prey. Maybe it has just captured a caddisfly larvae or one of the many stonefly species that can be found here. Both species of fish, you note, are Ozark endemics. The water is so inviting you spend a greater part of the afternoon investigating its treasures.

The sun is getting lower in the sky now. You decide it is time to turn back. Suddenly, a dragonfly whizzes by. It is the gray petaltail (*Tachopteryx thoreyi*) in pursuit of one of the many flying insects scurrying about. If you stay a little a longer,

maybe you will be lucky enough to see a gray bat (*Myotis griescens*). These bats fly along the stream corridor in search of small flying insects, including mosquitoes. But you decide that you need to get back to the real world and leave this wonderful place behind.

This wonderful place that you have just hiked can be found in Lake of the Ozarks State Park and is called Coakley Hollow Fen Natural Area. The element of water is what sustains these communities, which are comprised of an Ozark fen and a small spring-fed Ozark-Missouri headwater stream.

When compared to the landscape-size natural areas being designated today, this natural area is quite small. Although only 4 acres in size, it contains a large percentage of the parks most unique plant and animal species. When designated, the Ozark fen was identified as high quality because of its plant composition that includes conservative and state-listed species. The associated stream was deemed to be of high quality because it was within an intact, unimpaired watershed. But how do we really know the headwater stream, as an aquatic community, is high quality? And how do we assure that it is maintained as such?

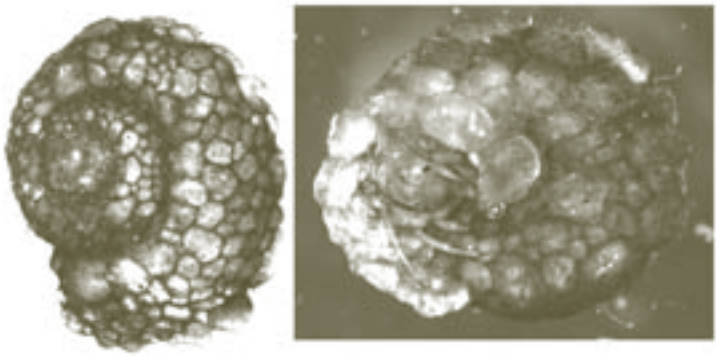
Starting in 1991 and continuing through 1996, a comprehensive inventory of the aquatic macroinvertebrates of the stream was conducted. These surveys had two goals: (1) to develop a complete species list of macroinvertebrates, and (2) to compare the data obtained from Coakley Hollow with other similar streams within Lake of the Ozarks State Park to assess its relative quality. Using the *Rapid Assessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish (EPA 440-4-89-001)*, with assistance from The Missouri Department of Natural Resources, Division of Environmental Quality, surveys were conducted four times a year.

Since these surveys were completed our understanding of aquatic systems and the metrics used to measure stream quality or integrity have advanced. While the original Rapid Bioassessment Method yielded good data, changes in the method have been made to provide more reliable measures of stream quality. Currently, there are four primary metrics used: Taxa Richness, the EPT Index, the Biotic Index and the Shannon Diversity Index. These may be combined with secondary metrics to obtain a variety of measures to interpret water or stream quality.

For the stream in Coakley Hollow, the number of species (taxa richness) far exceeds that found in other similar streams at Lake of the Ozarks State Park. In addition, if you look at the Quantitative Similarity Index for Functional Feeding Groups (a secondary metric), there is a healthy balance between the scrapers, shredders, filterers, collectors and predators. In comparison, when looking at the feeding groups found in other streams, this balance does not exist.

The EPT Index is the total number of distinct taxa of mayflies, caddisflies and stoneflies found in the stream. This value generally increases with increasing water quality. The measure summarizes taxa richness within insect orders

Coakley Hollow headwater stream with visitor center in the background
Missouri Department of Natural Resources



Helicopsyche, a snail case maker caddisfly that characterizes high-quality streams
Missouri Department of Natural Resources

(Ephemptera, Plectoptera, Trichoptera) that are generally considered to be pollution sensitive. Again, the stream in Coakley Hollow as compared to other streams has a higher index value.

One of the primary components of a stream macroinvertebrate bioassessment is that each species can be assigned a number based on how tolerant it is to pollution, with zero being not tolerant and 10 being extremely tolerant.

This is called a Biotic Index Value. Almost half of the species found during the survey have a value between zero and three, meaning that a great number of species found at Coakley Hollow are found in unpolluted, healthy waters.

Lastly, the Shannon Diversity Index provides a measure of community composition that takes into account both species richness and evenness. Diversity increases as the number of taxa increases and as the distribution of individuals among those taxa is more even. These data verify that Coakley Hollow most certainly is a high-quality stream, compared to other similar streams in the area.

Recognizing that Coakley Hollow's aquatic community is high-quality, how do we assure that it is maintained as such? The most significant threat to it would come in the form of erosion and sedimentation. Some sedimentation into a stream is natural and can be incorporated into a healthy, high-quality system. Too much sedimentation, however, can have a detrimental effect. Increased turbidity can reduce the stream's primary production by reducing photosynthesis, physically abrading algae and other plants and preventing attachment of primary producers to substrate surfaces. Too much sedimentation increases the erosive capacity of the flowing water, fills pools, and fills the small interstitial spaces needed by many of the aquatic invertebrates. Sediments blocking the gill passages can lower respiration capacity in many invertebrates. Certain feeding strategies such as filter feeding and visual predation may become less efficient.

Because this natural area is only 4 acres in size, how the Department of Natural Resources manages the surrounding state park land is of great importance. The adjacent surrounding communities are bottomland woodlands. The slopes above consist of dry-mesic chert and dry chert woodlands, with small dolomite glades on the hillsides. The broad flat ridges above the valley have remnants of upland flatwoods surrounded by dry chert and dry-mesic chert woodlands. These areas are being carefully managed using periodic prescribed fire to promote a healthy herbaceous layer and minimize erosion.

If the water quality in this natural area becomes greatly altered by sedimentation or chemical pollution originating outside of the park, these changes should be detected in the composition of the aquatic invertebrates found in the stream. In general, invertebrates found in headwater streams have a short generation time, high reproductive rates and their resting stages are resistant to unfavorable conditions. If species composition begins to change, this can be a signal that the quality of water that feeds the system is changing as well. Early detection of these changes by sampling the stream macroinvertebrates will alert the park staff to look closer at the entire watershed. Using stream macroinvertebrate bioassessment—along with other means such as chemical analysis of the water, plant surveys, bird surveys and terrestrial insect surveys—will help the Department of Natural Resources manage this area so that it remains a high-quality natural area into the future. ▲

Endemic Darters Highlight Unique Aquatic Natural Communities of the Missouri Ozarks

By Doug Novinger, Resource Scientist, Missouri Department of Conservation

The aquatic communities of Missouri reflect the uniqueness and diversity of a state at the intersection of distinct biogeographic regions. The Ozark Highlands, the Central Dissected Till and Osage plains, and the Mississippi Alluvial Basin are defined by landscape-scale traits that include differences in topography, geology, vegetative cover and soil composition (Nigh and Schroeder 2002). The streams and rivers that flow through these regions likewise assume characteristics imparted by the watersheds they drain, displaying unique combinations of gradient, flow, clarity and physical structure such as the types of bed material and amounts of woody debris (Pflieger 1989 and 1997, Sowa 2005).

A diverse and unique aquatic fauna evolved to exploit the habitats found in stream systems of each biogeographic region. This fauna provides the basis for an extraordinary natural resource that is a wonder to observe and a valuable indicator of ecosystem health via water and habitat quality that is found in few other states.

Despite the impressive level of biodiversity that Missouri streams boast, our aquatic communities bear the mark of negative impacts to watersheds and stream systems that have occurred over the last century and are reflected by the high degree of imperilment of our native fish fauna. For example, the Missouri Department of Conservation (MDC) currently lists 68 of its 227 fishes as species of conservation concern with 19 species considered endangered in Missouri. Two fishes, the Topeka shiner (*Notropis topeka*) and the pallid sturgeon (*Scaphirhynchus albus*), also are federally listed as endangered whereas three fishes, the Niangua darter (*Etheostoma nianguae*), the Neosho madtom (*Noturus placidus*), and

Maintenance of good water quality, habitat diversity (riffles, runs and pools), and minimally altered hydrologic regimes is critical to conserving Missouri's endemic darters and associated aquatic natural communities.
Missouri Department of Conservation, Doug Novinger

the Ozark cavefish (*Amblyopsis rosae*), are federally listed as threatened. Our challenge, to succeed at aquatic natural community conservation and maintain and protect the unique aquatic resources of Missouri, is as critical as it is daunting.

There are just four native fish species that occur only in Missouri and nowhere else in the world. All of the species happen to be darters, small, bottom-dwelling fishes in the perch family (Percidae, the same family as walleye) and include the brook darter (*Etheostoma burri*), the Missouri saddled darter (*Etheostoma tetrazonum*), the bluestripe darter (*Percina cymatotaenia*), and the Niangua darter. These fish are found in the clear, moderate to swift flowing streams of the Ozark Highlands in rocky habitats that are largely free of silt and with sufficient riffle habitats for spawning. The relatively narrow requirements of most darters for good water quality and minimally altered hydrologic regimes may explain the degree of imperilment of this group of fishes: 17 of the 36 darter species found in Missouri are considered species of conservation concern, with eight species listed by the state as endangered. This unique and diverse aquatic fauna combines with a high degree of impending threats associated with loss of stream habitats due to livestock impacts, erosion, urban development, and hydrologic alteration to rank the Ozark Highlands high on the list conservation priorities.

The brook darter was recently recognized as a separate species from the orangethroat darter (*Etheostoma spectabile*) and is restricted to the Black River and its tributaries in Missouri. The brook darter is a small (1-2 inches long), colorful fish common in slow-flowing riffles and pools where gravelly substrates are swept free of silt. No special protection is currently afforded this species.

The Missouri saddled darter is recognized by its brilliant colors and four dark crossbars across its back. Large pectoral fins are especially suited for maintaining position in swift, deeper riffles and runs underlain with coarse, rocky substrates. The Missouri saddled darter is a moderately large darter, reaching a length of 2 to 3.5 inches. It occurs in the Osage, Gasconade, Meramec and Moreau river watersheds where it is abundant in higher gradient reaches with continuous strong flow. Though the species does not have protected status, populations are vulnerable to impacts that degrade the quality of riffles where the Missouri saddled darter occurs.

The bluestripe darter is unique in both appearance and ecology (Pflieger 1984). It is a slender darter up to 3.5 inches long with dark, lengthwise parallel stripes that strongly resemble the stems of the waterwillow (*Justicia*) in which it is often found. The bluestripe darter occurs widely in the Niangua and Gasconade river watersheds along the periphery of slow runs and pools in aquatic vegetation over silt-free substrates. It is regarded as a species of conservation concern (S2, G2) due to its restricted distribution; however, populations appear to be relatively stable according to extensive surveys conducted in the 1940s, 1970s, and 1990s (Winston and Tilley 2003). Prospects for the long-term conservation of the species are enhanced because the bluestripe darter occupies stream systems that are for the most part continuous and free of substantial movement barriers such as large dams.

The federally listed threatened Niangua darter is a relatively uncommon inhabitant of the runs, riffles and shallow pools of a handful of north-flowing tributaries of the Osage River (Pflieger 1978). One of the largest darter species in Missouri (2.5-4.5 inches long), this colorful fish previously occurred

The Missouri saddled darter is found only in the swift riffles of some Missouri Ozark streams and nowhere else.
Missouri Department of Conservation, Doug Novinger

Isolated populations of the endemic (and threatened) Niangua darter inhabit just a few streams in the Osage River basin.
Missouri Department of Conservation, Jim Rathert

in several streams that were inundated and/or fragmented by the construction of large reservoirs such as Lake of the Ozarks, Pomme de Terre, Stockton and Truman. Populations of the Niangua darter and other stream fishes were already fragmented by numerous low-water "slab" crossings that were improperly designed for the passage of fish or materials. These crossings function as low-head dams when the culverts become plugged with gravel and result in an impounded pool upstream and large scour hole downstream that are poor habitat for darters and likely obstruct upstream if not also downstream movement. Isolated populations are vulnerable to extirpation by chance catastrophes; for example, extreme drought or chemical spills. Barriers also may inhibit the ability of fish to move among habitats, re-inhabit upstream reaches, and maintain adequate levels of genetic diversity.

Currently, populations of the Niangua darter appear stable in four of eight historical watersheds (Little Niangua River, Maries River, Pomme de Terre River, Tavern Creek) with low but consistent numbers of the species in one additional watershed (Niangua River). The species has not been observed in Sac River watersheds (Bear Creek, Brush Creek, North

Conservation activities, such as replacement of this creek crossing, remove fish passage barriers, thereby benefiting aquatic habitat and improving fish community diversity in Ozark streams.
Missouri Department of Conservation, Doug Novinger

Dry Sac River) since the mid-1990s. In addition to population fragmentation, other factors such as sedimentation from poor land use practices, channelization, and improper gravel removal have likely played roles in reducing the range of the Niangua darter and pose conservation challenges for the future.

Recently, the Niangua River basin (including the Little Niangua River and its tributaries) was established as a Conservation Opportunity Area and part of the Comprehensive Wildlife Strategy. This designation will benefit the bluestripe and Niangua darters by focusing funds and conservation activities in watersheds that are critical for the protection of both species. Three low-water crossings, two in the Little Niangua River and one in the Tavern Creek watershed, have been replaced with clear-span bridges to reconnect several miles of previously fragmented stream reaches and improve habitat. In addition, several major streambank stabilization projects are underway in the Little Niangua and Maries river watersheds to halt erosion. These activities coupled with extensive, long-term monitoring of fish communities and habitat are important steps toward conserving the unique aquatic natural communities of the Ozarks. ▲

Nigh, T.A. and W.A. Schroeder. 2002. Atlas of Missouri ecoregions. Missouri Department of Conservation, Jefferson City.

Pflieger, W.L. 1978. Distribution, status, and life history of the Niangua darter, Etheostoma nianguae*. Missouri Department of Conservation, Aquatic Series No. 16.*

Pflieger, W.L. 1984. Distribution, status, and life history of the bluestripe darter, Percina cymatotaenia*. Missouri Department of Conservation, Aquatic Series No. 18.*

Pflieger, W.L. 1989. Aquatic community classification system for Missouri. Missouri Department of Conservation, Aquatic Series No. 19.

Pflieger, W.L. 1997. The Fishes of Missouri. Missouri Department of Conservation, Jefferson City, Mo.

Sowa, S.P. 2005. A Gap Analysis for Riverine Ecosystems of Missouri. Missouri Resource Assessment Partnership Final Report, submitted to the USGS National Gap Analysis Program.

*Winston, M.R. and R.P. Tilley. 2003. Status of the Missouri-endemic bluestripe darter (*Percina cymatotaenia*). Transactions of the Missouri Academy of Sciences 37:26-30.*

Horton Bottoms Natural Area: Restoring and Managing a Wet Prairie/Marsh/ Bottomland Forest Complex

By Emily Horner, Natural History Biologist, Missouri Department of Conservation

The distinctiveness of Missouri's landscape and diversity can often be difficult to observe. Much has been so severely fragmented, cleared or altered that at times only a few species afford identification. The diverse wet prairie, marsh and bottomland forest natural community complexes have met this fate in southwestern Missouri. Clearing of prairie for crops and subsequent leveeing to control floodwaters, together with harvesting of trees and channelizing of streams and rivers have left only a small fraction of these once expansive communities in Missouri. But all is not lost.

A natural area...is a geographic unit of any order of size with sufficient common characteristics of various sorts to be of some practical usefulness in biogeography.

S.A. Cain, 1947, in *Characteristics of Natural Areas and Factors in their Development*.

While Four Rivers Conservation Area is known for its phenomenal duck hunting success, a trip between the Little Osage and Marmaton rivers within the southwestern unit of Four Rivers CA affords a different and unique aquatic experience. Horton Bottoms Natural Area, at 227 acres, contains some of the last remnants of the wet prairie expanse in Missouri, together with extensive freshwater marsh, shrub swamp and bottomland forest, as well as a headwater stream leading to the Little Osage River. This area as a whole is the premier natural floodplain ecosystem in the Osage Plains Natural Division.

Level Osage silty clay soils dominate the area, allowing for very slow permeability and subsequent seasonal wetness and local ponding of water. Occurring throughout the natural area are species such as *Spartina pectinata* (cordgrass), *Carex*

hyalinolepis (a sedge) and *Scirpus fluviatilis* (river bulrush), together with shrubs and trees, including *Cephalanthus occidentalis* (buttonbush), *Fraxinus pennsylvanica* (green ash) and *Salix nigra* (black willow).

While the hydrology of the Marmaton and Little Osage rivers underwent minor modifications, more significant alterations of the natural hydrology took place within the wet prairie, marsh, bottomland forest complex of the natural area surrounding the rivers. A drainage ditch lies within the western one-third of the natural area. Prior to 1939, channelization of the natural drainage occurred within what is now Horton Bottoms to expedite drainage into the headwater stream leading to the Little Osage River. Missouri Department of Conservation staff speculate that the wet prairie and freshwater marsh communities began to change as surface water retention lessened within the marsh and ground water levels decreased. Woody encroachment, along with the loss of herbaceous wetland and wet-prairie species, followed.

However, over the past decade significant efforts have been underway by MDC staff to lessen these impacts (and armies of mosquitoes have been fought to do so). In 1997, staff initiated a study on how to restore the natural hydrology of this unique landscape. In the summer of 2001 sediment retention dams (ditch checks) were placed within the drainage ditch to begin restoration of the natural hydrology. The ditch required three dams to slow the flow energy of the floodwaters and allow for backwater from the Marmaton River to deposit sediment loads within the ditch. The dams were replaced in 2003, after the original dams were damaged and removed by flooding, using softwood timber harvested on-site. After three years and several flooding events within the natural area, minor sediment deposition has occurred. Time and future inundations should lead to deposited sediment eventually filling in the ditch to meet the natural elevation of the surrounding landscape, thus increasing surface and groundwater levels within the natural area.

In addition to the sediment retention dams, Truman Reservoir, constructed in the late 1970s, facilitates in the seasonal flooding of Horton Bottoms. During wet years, Truman Reservoir often provides more frequent and prolonged flooding within Horton Bottoms. This is both a benefit and a potential detriment to the natural communities. The flooding secures seasonal water within the marsh and wet prairie communities, but can remain within the bottomland forest for disproportionate periods of time. Prolonged inundation within the bottomland forest may inhibit hardwood regeneration and cause tree mortality, as it has within other portions of the Truman Flood Easement.

Recent years of drier conditions increased the accessibility of Horton Bottoms, allowing contractors to reduce black willow and green ash encroachment. Wildlife Habitat Enhancement funds provided the avenue for 40 acres of tree and shrub removal efforts in the fall of 2002. Josh Cussimanio, wildlife biologist at Four Rivers CA, noted a

Sediment retention dams were built in 2001 to increase sediment deposition into the channelized ditch, thus increasing surface and groundwater levels over time at Horton Bottoms NA.
Missouri Department of Conservation, Norman Murray

Response of river bulrush and sedges is evident after two years of black willow and green ash control within the freshwater marsh at Horton Bottoms NA.
Missouri Department of Conservation, Rick Thom

Cordgrass and sedges are dominant on much of the wet prairie at Horton Bottoms NA.
Missouri Department of Conservation, Emily Horner

Over the past three years state wildlife grants have funded over 70 acres of woody encroachment control within the freshwater marsh and wet prairie.
Missouri Department of Conservation, Chris Daniels

A lake…forms a little world within itself—a microcosm within which all the elemental forces are at work and the play of life goes on in full, but on so small a scale as to bring it easily within the mental grasp.

S.A. Forbes, 1887, in *The Lake as a Microcosm*.

significant response of sedges and river bulrush evident the second year after the removal efforts. Wildlife Diversity Funds aided in cutting and piling of an additional 40 acres of woody encroachment in the spring of 2005, which eliminated over 75 percent of the woody competition.

Also within 2005, Horton Bottoms NA became a focus area within the Marmaton/Wah' Kon-Tah Conservation Opportunity Geography, which is a target of the Missouri Comprehensive Wildlife Strategy. Targeted conservation strategies include conserving and restoring bottomland natural communities and restoring hydrology where appropriate, as well as increasing public awareness and participation in natural community restorations. Again in 2006, Wildlife Diversity Funds were used to remove another 20 acres of undesirable woody vegetation to complete the clearing of the natural area.

Dry weather has also allowed Chris Daniel, wildlife management biologist at Four Rivers CA, to initiate plans for a prescribed burn of Horton Bottoms. The last fires occurring within the natural area took place approximately 10-15 years ago. With burn lines installed, the Four Rivers staff plan to conduct a prescribed burn this winter. By December, the piles of cut woody debris will have cured and the drip torch will be ready. By next spring, a visit to Horton Bottoms should show an even greater response of sedges, river bulrush and cordgrass resulting from the hard work and combined restoration efforts.

Future prescribed burns will continue on a 3-5 year cycle when drier weather prevails, with the goal of reducing black willow sprouts and other aggressive woody vegetation, while also removing litter accumulation and stimulating native herbaceous flora.

Moneywort, a low-growing, mat-forming exotic species from Europe, pervades within the natural area and the Marmaton/Osage River riparian zones. We are uncertain how best to control this species, or whether control is even possible. Early spring or fall prescribed burns may help control the advancing moneywort. However, unless feasible and economical control efforts are developed for the whole Marmaton/Osage Basin, control efforts in Horton Bottoms might be short-lived. It is hard to escape exotic species, even in high-quality natural communities. The challenge continues.

MDC staff are currently working on expanding the boundaries of the existing natural area to encompass the adjacent bottomland forests and woodlands, as well as the additional wet prairie and marsh habitat surrounding Horton Bottoms NA. For a closer look at the unique landscape and the management efforts undertaken, you can travel by foot or by boat. The route along the Little Osage River winds through the larger expanses of beautiful bottomland forests and woodlands that may soon become part of the larger natural area boundary. ▲

Chariton River Hills Natural Area, Long Branch State Park, Macon County

By Mike Currier, Natural Areas Coordinator, Missouri Department of Natural Resources

"James Lamb came in November, 1837, from Casey County, KY [Kentucky] ... There were no settlements on the prairie. A road ran north and south through the township [Jackson Township in Randolph County] called the "Bee Trace," so-called from the fact that it was the route traveled by the old pioneers who hunted wild honey and sold it for twenty cents a gallon."

(Excerpt from *A Directory of Towns, Villages, and Hamlets Past and Present of Randolph County, Missouri* Compiled by Arthur Paul Moser)

In the 1820s pioneers from Kentucky, North Carolina, Virginia and other origins settled in the wooded areas of north-central Missouri, in what was to become Randolph, Macon and Adair counties. Many traveled on an indistinct ridge called the Grand Divide (Beveridge 1990) that separates the watersheds of the Mississippi River and Missouri River. To the east water flows through the Salt River drainage into the Upper Mississippi River and to the west through the Chariton River drainage into the Missouri River.

An ancient road used by native Americans and early settlers roughly followed the western edge of the Grand Divide. It traversed the high plains dominated by tallgrass prairie (Claypan Till Plains) and skirted the wooded river hills of the Chariton River (Chariton River Hills) (Nigh and Schroeder 2002). This loess and till covered landscape of tallgrass prairie, oak savanna "orchards," oak woodland, bottomland forests, ephemeral marsh wetlands and sinuous streams provided a diverse assortment of habitats supporting many species, some of which are rare or nonexistent today.

The local folk described it as the Bee Trace, where enterprising honey gatherers of all ages and backgrounds set out to fill their buckets in the fall to set up stores for the winter. In an interesting twist, honeybees (*Apis mellifera*) were imported from Europe in the seventeenth century and became widely naturalized throughout the plains of North America before settlers arrived. The "wild" naturalized bees collected nectar and pollen from the abundant wildflowers of the prairies and savannas, and constructed honey-filled hives in the hollow cavities of trees lower down in the watershed, where woodlands supplied a protective overstory. In the cool, crisp autumn air, as tradition would have it, early settlers like James Lamb followed a "beeline" in search of honey trees, for the liquid gold they contained—a tradition that continued well into the twentieth century.

One of the newest natural areas in the state is the Chariton River Hills Natural Area, owned by the U.S. Corps of Engineers' Kansas City District and leased and managed by the Missouri Department of Natural Resources at Long Branch State Park. The designation recognizes the Bee Trace Unit (385 acres) and the West Chariton Prairie Unit (45 acres) as significant natural communities representative of the landscape that occurred historically in the Chariton River Hills Subsection of the Central Dissected Plains of Missouri. Combined, these units include prairie, savanna and woodland on loess/glacial till soils. What originally were small, unmanaged remnants have achieved

Restoration of this rare prairie remnant gives one a glimpse of what settlers experienced as they traveled and settled in northern Missouri.
Missouri Department of Natural Resources

Missouri Department of Natural Resources

natural area status as significant benchmarks. This is a result of 20 years of management by the Missouri Department of Natural Resources. Prescribed fires along with localized control of invasive woody species are the management techniques that have been used to restore this historic landscape. Now, over 300 species of native vascular plants have been identified. The area is known to support Henslow's sparrow, red-headed woodpecker, dickcissel and orchard oriole—all priority bird species of the Dissected Till Plains for conservation efforts.

In the future other units may be added to the Chariton River Hills Natural Area to represent the range of natural communities of this unique area. These remnants are significant natural resources preserving the native plants, animals, and communities of the Chariton River Hills. In addition they preserve remnants of an historic landscape where early settlers made their homes in the woodlands below the Grand Divide, the "high" ridge that separates the upper watersheds of two large Missouri rivers. ▲

Beveridge, Thomas R.,1978, 1990. Geologic Wonders and Curiosities of Missouri, (second ed. rev. Jerry D. Vineyard), Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Mo.

Nigh, Timothy A. and Walter A. Schroeder, 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation. xii plus 212 p.

Richard (Rick) H. Thom Retires from MDC

By David Urich, Missouri Department of Conservation

Rick Thom started his career with the Missouri Department of Conservation in 1978. He came to Missouri with two years of experience as a field biologist for the Illinois Nature Preserves Commission. There he worked for George Fell, who was a founder of The Nature Conservancy and the Natural Areas Association. One of Rick's projects in Illinois was searching railroad rights-of-way and pioneer cemeteries for remnant prairie plants, occasionally locating tiny remnants of high-quality prairie in the highly altered farm landscape of the Prairie State.

In 1978 Rick joined MDC's new Natural History Section as the agency's first natural areas coordinator. Rick developed a sound framework for expanding the natural area system. He and Endangered Species Coordinator Jim H. Wilson developed *The Natural Divisions and Sections of Missouri* as the basis for an ecological classification of native habitats and to guide the expansion of the natural area system. It also started MDC down the path of ecological classification of land and habitat for management decisions. He helped develop the Heritage Data Base which documents the location of the state's unique natural communities and special status plants and animals. Rick also developed and guided a statewide comprehensive natural features inventory to search for remaining natural communities, evaluate their quality and inventory their plants and animals. This inventory data populated the Heritage Database and provided decision-making for land acquisition, natural area nomination, and environmental reviews for MDC and conservation partners such as The Nature Conservancy and the Missouri Prairie Foundation.

Rick was promoted to assistant administrator of Natural History Division in 1988 and to Natural History Division administrator in 1995. He emphasized partnerships with conservation and environmental organizations such as the Missouri Prairie Foundation, Audubon and The Nature Conservancy to jointly promote natural community management, restoration, land acquisition, endangered species conservation, and natural area designation of appropriate tracts. He served on the board of MPF and helped establish the Missouri Native Plant Society to engage Missouri citizens who were interested in plant conservation and ecology.

Rick was involved in MDC's acquisition of many important tracts that preserve unique natural features. Many of the prairies currently owned by MDC were promoted and recommended for purchase by Rick. He nominated Paint Brush Prairie, MDC's first prairie purchase with the conservation sales tax, as a Missouri natural area. He supported the acquisition of many more prairies including Hite, Drovers, Ripgut, Osage, Sky,

Rick Thom enjoys an outing on the Missouri River. *Missouri Department of Conservation, David Urich*

Diamond Grove, Star School, Pawnee, Stony Point and others. He was involved in acquisition or natural area designation of scores of MDC lands. A few of them are Buford Mountain, The Sunklands, Caney Mountain, Barn Hollow, Pickle Springs and White River Balds.

Rick served as either a staff person or member of the Department Natural Areas Committee for his entire career with the agency. He served several terms as chair of the interagency Missouri Natural Areas Committee. He dedicated himself to including Missouri's best remaining natural communities in the natural areas system. A sound system of ecological classification of natural communities was necessary to guide the selection of natural areas. Rick promoted staff and funding support for the Terrestrial Natural Communities of Missouri by Paul Nelson, which classified communities, established the basis for selecting sites for inclusion in the natural areas system, and guided land managers.

Natural communities and species of conservation concern require special expertise for management and public understanding. Rick promoted the establishment of a new MDC field position—natural history biologist. He recruited and deployed 10 natural history biologists throughout the state, attracting a well-qualified staff who understood natural community restoration and management, and dedicated to promoting the conservation of biodiversity. He led the development of MDC's Cave Biology Program, which is a national model among state fish and wildlife agencies for cave and karst conservation. He understood the importance of getting Missouri citizens out to see and enjoy the state's natural communities and unique features. He developed a recreational program in the Department to help staff with trails, campgrounds and other forms of outdoor recreation.

As Natural History Division administrator he dedicated staff to outreach efforts and encouraged a series of exceptional books such as the *Birds in Missouri*, *Flora of Missouri* revision, *Breeding Bird Atlas*, *Trees in Missouri* and others.

Beginning in the late 1990s, Rick dedicated time to increasing federal funding for wildlife diversity and helping state wildlife agencies improve effectiveness and capacity for wildlife diversity conservation. He was active in a national group of Wildlife Diversity Managers to improve management and restoration of all wildlife and plant species. In cooperation with the Conservation Federation of Missouri, he formed a statewide coalition of conservation organizations to support Teaming with Wildlife to seek greater Congressional funding for fish and wildlife conservation. Missouri became a lead state in promoting national legislation that eventually resulted in the State Wildlife Grant Program. Over $1 million dollars comes to MDC annually from this program for wildlife diversity conservation. The expenditure of this money is guided by the Comprehensive Wildlife Strategy completed in October 2005, an agency plan for the conservation of all wildlife and their habitats, which was developed under Rick's guidance. Rick's dedication to all wildlife conservation in Missouri was recognized by the Conservation Federation of Missouri in 2000 when CFM named him the Professional Conservationist of the Year. In 2003, Rick became the wildlife diversity chief in Wildlife Division responsible for statewide programs in natural areas, endangered species, invasive species, bird conservation and others. In 28 years with the Department of Conservation, he developed MDC's wildlife diversity efforts into a nationally recognized, comprehensive program that is integrated within the agency's broad mission, values and actions.

Congratulations Rick! ▲

MISSOURI
Natural Areas
NEWSLETTER
Fall 2006

Calendar of Events

Jan. 31-Feb. 2, 2007

2007 MISSOURI NATURAL RESOURCES CONFERENCE

Tan-Tar-A Resort and Golf Club at Lake of the Ozarks, Osage Beach, Mo.
www.mnrc.org
Theme: Conserving all natural resources: Implementing the Comprehensive Wildlife Strategy

Feb. 9-16, 2007

60TH ANNUAL MEETING, SOCIETY FOR RANGE MANAGEMENT

John Ascuaga's Nugget, Reno-Sparks, Nev.
www.rangelands.org
Theme: Traditions and Transitions

March 6-8, 2007

11TH ANNUAL MISSOURI RIVER NATURAL RESOURCES CONFERENCE

Lied Conference Center, Nebraska City, Neb.
Purpose: Foster working relationships among basin interests and users, and increase knowledge about the basin.
Contact: Vince.Travnichek@mdc.mo.gov
(816) 271-3111, ext. 226

March 20-24, 2007

72ND ANNUAL NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE

Hilton Portland and Executive Tower Hotel, Portland, Ore.
Special Sessions: Conservation and the Fuels Game; Casting a Broader Net for Fisheries Management; The Future of Wildlife on Private Forest Land: Going Out on a Limb; Targets of Opportunity: State Wildlife Action Plans

April 22-27, 2007

2ND NATIONAL CONFERENCE ON ECOSYSTEM RESTORATION

Hyatt Regency, Crown Center, Kansas City, Mo.
Purpose: Provide a forum for scientists, engineers, resource managers, planners and policy-makers to share information concerning ecosystem restoration throughout the United states.
Theme: The Spirit of Cooperation…Integrating Partnerships between Science and Management for Sustainable Ecosystem Restoration

COMMENT FROM THE EDITOR. . ..

Three factors set this issue of the *Natural Areas Newsletter* apart from prior issues. First, the focus of this and next spring's issues is aquatic natural communities–their history, classification, features and conservation. Second, the newsletter has received a facelift, with new paper, colors, fonts and layout design–all intended to make the newsletter more reader-friendly. Finally, this issue is available on-line at www.mdc.mo.gov/12220. We hope you enjoy these changes and that you will pass the word to your colleagues.

Wayne Porath, Editor

Serving nature and you

Missouri Department of Natural Resources

MISSOURI Natural Areas NEWSLETTER

Printed by:
THE MISSOURI DEPARTMENT OF CONSERVATION

Invitation from the editor: Readers are encouraged to submit articles, letters and items for the *Missouri Natural Areas Newsletter*. Please send submissions for the spring 2007 issue by March 15, 2007, to Wayne Porath, editor. Word 97 (or better) documents sent by e-mail are preferred. Send them to: Wayne.Porath@mdc.mo.gov.

Missouri Department of Conservation
P. O. Box 180
Jefferson City, MO 65102
Phone: 573/751-4115
FAX: 573/526-4663

For a free copy of the *Missouri Natural Areas Directory*, write to Mike Leahy, Natural Areas coordinator, at the address above.